BIG DATA **TRANSPORT**

Innovative Data Center Connectivity

ADVA™ Optical Networking

Data Center Interconnection

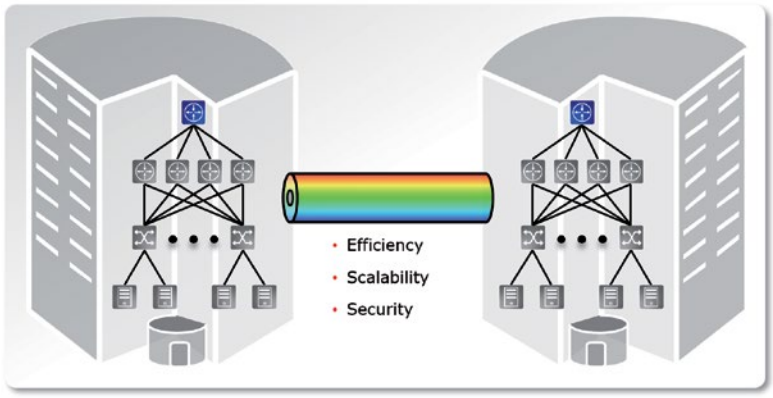
The last decade has witnessed the rise of social networks, over the top media distribution, mobile overtaking fixed broadband and many more trends all leading to building of hundreds of mega data centers around the world. As data centers have continued to balloon in size and number, the applications they run have outgrown their walls, becoming global content databases in the process. The global scale of data center databases and networks has created the need for truly massive amounts of data to be transported between the various geographic sites. Whether for load balancing, replication, and/or business continuity, the dawn of Big Data Transport has arrived.

Early data center interconnection networks simply made best use of whatever network resources and technologies were readily available. Yet, as the percentage of total transport bandwidth consumed by data centers has begun to eclipse that of traditional telecommunications, data center operators have started to ask for network technology optimized for their application. ADVA Optical Networking understands the unique needs of data center operators and provides products specifically designed for each Big Data Transport application.

Efficiency

Just as "beauty is in the eye of the beholder", similarly network "performance" may be different depending upon the application. For data center operators, efficiency is a key part of network performance. In other words, instead of highest absolute performance at any cost, they are seeking highest performance per Watt, dollar, or square meter floor space. Both the size and growth rate of data centers demand a close focus on total efficiency.

The energy demand of mega data centers is well documented, and the need to locate them near hydro-electric dams and other types of power plants speaks volumes. Power is a double hit. Every Watt consumed by equipment must not only be provided, but thermally dissipated as well. Recently, many data centers have made the decision to intentionally run their entire complex at an elevated hot temperature, rather than force cooling them to normal ambient temperatures. And, power sometimes brings a triple hit, as additional taxes may be levied to compensate for the additional burden on local resources, infrastructure, and environment.



Space efficiency is important as well. Whether leased or owned, campus or shipping container, every square meter of floor space and rack unit of rack space has a cost associated with it. Mega data centers are reaching the limits of what can be built today, thus shifting the focus from growing bigger to getting more out of what they have already built. Having expanded to the limits of what their internal infrastructure can handle, it is now not uncommon for a data center to run out of space before hitting other resource limitations first.

Scalability

While data centers must plan for exponential and often unplanned growth, there is the reality of building within today's fiscal constraints. Data centers today still provision mostly 10Gbit/s and below links. Yet, the percentage of higher speed links such as 40G and 100G links is rapidly growing, and 400G is just around the corner. Which is why future scalability of any solution they deploy today is so important. All data rates may have to coexist on the same fiber and transport platform simultaneously.

FSP 3000 – Efficient, Scalable, Multiprotocol Transport

The FSP 3000 family is the most efficient way of transporting data available today. The 300mm depth chassis is half the depth of most WDM transport equipment. Terabits/s of traffic can be transported by a single shelf. Power levels below a Watt/Gigabit/second can be achieved. And our 100G direct-detection technology costs less than running an equivalent 10 x 10GbE connection.

The FSP 3000 scales seamlessly from 10G, 40G, 100G, and soon 400G connectivity. A data center can install a single 10G wavelength today with confidence the existing solution will expand to 192 – 100G channels with no fork lift upgrades or service downtime. And all data rates can peacefully coexist on the same fiber, with no guard bands or awkward configuration rules needed.

Data Center Operator vs Traditional Telecommunications Provider

- Telco equipment needs to last decades, while a DCO might replace in fast moving technology cycles (e.g. 3 years).
- Telco wants best optical link performance (Bits/s/km/Hz), while DCO wants best performance for given efficiency (Bits/s/W).
- Telco's historically demand 99.999%, "5 Nines", while a DCO may find 3 nines "good enough".
- Telco's spec a wide temp range around ambient, while DCO's spec a narrower temp range and may run hot.
- Telco's rely on rings and mid-span access, while DCO prefer point-to-point and "bookended" amplifiers, at least for now.

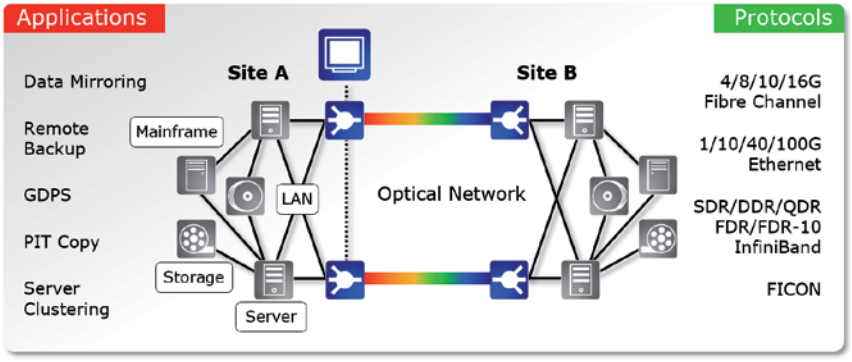
Business Continuity

Big Data is also big business. The growth of the cloud, data centers, and content providers has meant Big Data is now a substantial percentage of the Gross National Product of most developed nations. But, just as fast as the revenue is created almost magically, seemingly out of thin air, it can also disappear overnight unless a business continuity plan is in place. Big Data must not only be stored, but also backed up. In fact, all business data needs backed up, big or small. Whether a SMB or Fortune 500, hospital or utility, a business continuity plan is key to survival.

Synchronous Mirroring

The total loss of mission-critical data is a highly threatening prospect that can destroy a company's business future. For this reason, governments have stepped in with regulations that seek to protect both businesses, the taxes they generate, as well as end consumers from loss. Sarbanes-Oxley and Health Information Portability and Administration Act (HIPAA) in the US, and Basel II Capital Accord framework in Europe are but a few examples. Two key components of these regulations are mandatory geographic dispersal of stored information and minimum data retention periods that can stretch into decades, depending upon the industry. Both require application specific transport networks to satisfy.

The predominate form of data backup today is synchronous disk mirroring in which an instant copy of each new data set is automatically sent to a remote site. With this method, the storage of a piece of data is not complete until a handshake between the main and remote site is complete. Thus, distance and latency greatly impact performance. The faster the data pipe, the lower the latency, the more data can be mirrored in a given amount of time.



Fast, Low-Latency & Native Multiprotocol Support

ADVA Optical Networking is at the forefront of Storage Area Networking (SAN) and Business Continuity technology. The FSP 3000 has always been first to support the latest Fibre Channel speed steps, the latest being 16GFC with up to 3200 Mbytes/sec full duplex throughput. When WAN length distances are involved, the move from 4GFC to 16GFC gives more than a simple 4X throughput improvement as the higher speed also reduces time between handshakes. All latency inducing components of the FSP 3000 are optimized for lowest latency possible so that for a given link distance, throughput is maximized.

Most data networks today tend to be IP/Ethernet. The protocol translation between Fibre Channel to Ethernet or FCoE adds additional latency at every point of conversion. The ADVA FSP 3000 is able to natively transport Fibre Channel with no latency inducing protocol conversions needed. In fact, all SAN protocols are supported including FICON, 4/8/10/16G FC, 1/10/100GbE, and SDR/DDR/QDR/FDR/FDR-10 InfiniBand. No longer are rows and rows of equipment needed for translation and transport as the FSP 3000 can natively encapsulate them all into a single efficient, low-latency transport link.

The ADVA FSP 3000
Scalable Optical Transport Solution

BigData Transport

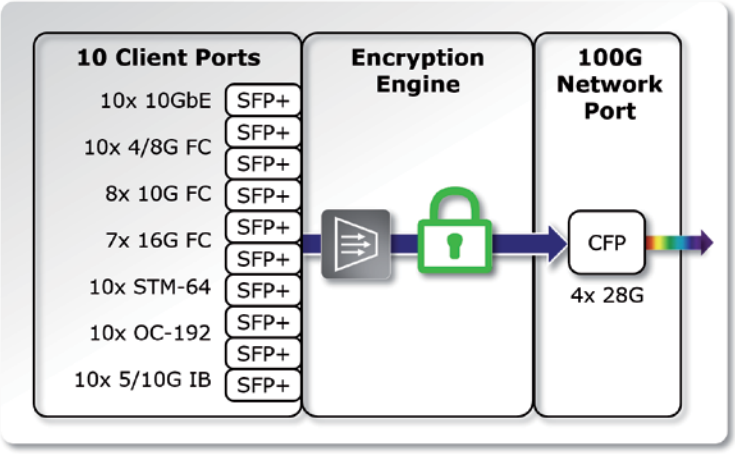
Security

The explosive growth in Big Data has been spurred by a rapid migration to the "cloud". And for all the hype and buzzwords, when distilled to its basic essence, data has moved from a data owner's personal hard drive to a hard drive owned by someone else. With that move of Big Data to the cloud comes an implicit trust that the data will be just as secure as before. If that trust is somehow broken, then the market has shown itself relentless in response. Fast rising companies have almost disappeared overnight when breaches in security have come to light. Securing Big Data has grown just as important as gathering it.

Traditionally, cloud providers have relied on encrypting the uplink/downlink between user and cloud. However, recent revelations of wide scale eavesdropping have demonstrated that data is also vulnerable when traveling laterally between secure data centers. An important piece in securing Big Data, and maintaining the trust of end users, is to protected it as it travels on the physical fiber plant.

In-Flight Encryption

In-flight encryption refers to encrypting data at layer 1 in network protocol stack. Layer 1 is the physical transport layer of the network, where the fiber resides. Traditionally, Big Data is encrypted at higher layers in the stack; For example, IPsec is implemented at layer 3, the packet switching layer. In-flight encryption is on top of (in addition to) any existing encryption and may be combined with other methods to increase security. One unique feature of in-flight encryption is no additional overhead is added to data stream. For example Overlay Transport Virtualization (OTV), a commonly used IP VPN service protocol adds 82 bytes overhead. If a shorter packet is transported with OTV, loss of throughput will occur. Most financial exchanges have standardized on a 128 byte packet structure. Transporting 128 byte packets over an OTV link will reduce total link throughput to 60%. With zero overhead, in-flight encryption maintains full throughput, completely independent of packet size.



Bulk Encryption

ADVA Optical Networking takes in-flight security one step further by using bulk method encryption. In traditional encryption, the only parts of a packet that are encrypted are related header bits and the payload. Encryption only guarantees the confidentiality of a message, and does not protect against manipulation. It is the job of the checksum to protect the integrity of a message by detecting manipulation. In standard encryption, the checksum is not part of the encrypted message, allowing the message to be modified and then the checksum updated. In bulk encryption, the entire packet is encrypted, including the full header and checksum, thus preventing the checksum from being updated, and guaranteeing the integrity of each packet.

Another huge benefit of bulk encryption is being protocol/interface agnostic. While other encryption methods only support Ethernet frames, bulk encryption can simultaneously encrypt Ethernet, Fibre Channel, InfiniBand, and SONET/SDH into the same bulk container. A wide variety of data rates and protocols can all be aggregated into a single encrypted transport channel.

100G In-Flight Encryption

The challenge to in-flight encryption is that by operating at the transport layer, it must also keep up with prevailing transport data rates. As the Big Data pipes between data centers have gotten fatter, they have also gotten faster. 100G links are becoming more common. When competing in-flight encryption systems topped out at 10Gbit/s, Big Data providers had to make the difficult choice between running unencrypted at 100G, or link aggregating 10 x 10G encrypted ports. Well, Big Data is no longer in that difficult position, as the ADVA FSP 3000 supports both 10G and 100G in-flight, bulk encryption. Any combination of protocol and data rate can be grouped together and transported with 100% throughput over a channel.

Key Benefits of Our Transport Encryption

- In-flight encryption secures Big Data where it is most vulnerable
- No additional overhead means no loss of throughput with small packet sizes
- Bulk encryption includes header and checksum, providing integrity
- Any data rate, any protocol can all be aggregated and sent over a single encrypted lane
- Encryption manager can be run completely separate from Network Manager

Software-Defined Networking

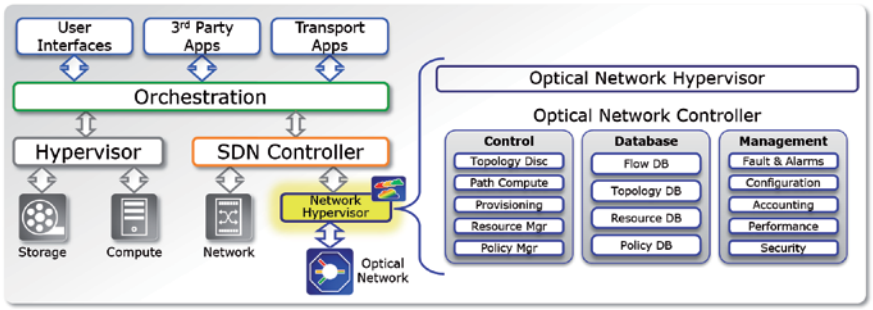
The amount of data processed in data centers is growing at a staggering 50% CAGR which is driving data centers to evolve. While virtualization and automation enable elastic resource scaling inside the data center, then the outside data center connectivity (WAN) starts to become the bottleneck.

Storage migration and replication, machine cluster migration, and distributed applications all require high speed connections to reduce transfer times and increase network throughput. Dimensioning the WAN for peak capacity leads to an overprovisioning of the network and an inefficient resource usage. Transport SDN can turn the WAN into a programmable resource and provide bandwidth-on-demand on a calendared or ad-hoc basis. WAN virtualization allows a resource sharing between multiple tenants. Through integration with cloud orchestration, resources become virtualized both inside and outside the data center, working in tandem for truly elastic cloud services.

Controlling Global Networks

As the cloud has continued to grow, two trends have threatened to stifle that growth. First, the sheer scale of the databases and interconnecting networks is staggering, becoming truly global in nature. The control mechanisms that worked for regional networks do not necessarily work on a global scale. Second, the type of traffic being carried has changed with end user applications. The majority of traffic now consists of data flows from caches to consumer, rather than random packetized information between nodes. Both trends are requiring a rethink in the way an IP network should be controlled.

Currently, networks use distributed control in that they make their own decisions based upon messages they relay to each other. Software-Defined-Networking has offered a way of centralizing that control by allowing routers to report to data center hypervisors through an orchestration layer. It is this orchestration layer that promises to allow the cloud to continue to grow without bound. But, while centralizing control is certainly a step in the right direction, if true multilayer optimization of data flows is to be achieved, the transport layer must be included in this control.



Extending SDN to Transport

The transport layer tends to be complex, analog, and proprietary in nature. To expect existing SDN controllers designed for IP switching to handle the extra work load might be asking too much. The solution is to abstract the transport network into a more simplified form that is more easily understood by the SDN controller. The ADVA FSP 3000 Network Hypervisor virtualizes the entire transport network and connects to any standard SDN Controller such as an OpenDaylight. The orchestration layer now has full control of data traffic across all network layers and elements, virtual or real, so that true multilayer optimization of packet flows can be achieved.

Keeping Up With Growth

The answer to the problem of keeping up with the growth of the cloud is not simply building data center networks faster, but rather using existing resources more efficiently. Today's IP networks are intentionally provisioned to 30–40% of maximum capacity to allow for normal traffic variations. Always building and provisioning for peak traffic is a losing proposition. A better solution is to make data center networks more flexible, able to respond to both expected and unexpected changes in traffic volume. A recent study by a major data center operator found that efficiencies as high as 98% could be achieved today through centralized control of end-to-end data flows. Doing so everywhere would be the equivalent of doubling the size of the global cloud and Internet overnight. The ADVA FSP 3000 Network Hypervisor is a major step in that important direction.

Real World Use Cases for Transport SDN

- Proactive bandwidth calendaring lets your network morph to best fit daily trends
- Reactive bandwidth calendaring lets you respond to unexpected demand spikes
- Follow-the-sun allows global networks to shift resources based on time zones
- Automatic virtual machine migration tools can call up new wavelengths as needed to better balance loads across geographically dispersed servers
- Get more out of existing network resources, just through more intelligent control

For More Information

ADVA Optical Networking SE
Campus Martinsried
Fraunhoferstrasse 9a
82152 Martinsried/Munich
Germany

ADVA Optical Networking North America, Inc.
5755 Peachtree Industrial Blvd.
Norcross, Georgia 30092
USA

ADVA Optical Networking Singapore Pte. Ltd.
25 International Business Park
#05–106 German Centre
Singapore 609916

info@advaoptical.com
www.advaoptical.com

About ADVA Optical Networking

At ADVA Optical Networking we're creating new opportunities for tomorrow's networks, a new vision for a connected world. Our intelligent telecommunications hardware, software and services have been deployed by several hundred service providers and thousands of enterprises. Over the past twenty years, our innovative connectivity solutions have helped to drive our customers' networks forward, helped to drive their businesses to new levels of success. We forge close working relationships with all our customers. As your trusted partner we ensure that we're always ready to exceed your networking expectations. For more information on our products and our team, please visit us at: www.advaoptical.com.

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